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ABSTRACT

The world is dominated by the technological applications of scientific ideas and by the naturalistic empirical way of thinking characteristic of science. Also in this world, many people rightfully place great importance on their faith in a supernatural being and their membership in a church. The U.S. is a highly pluralistic society represented by many different religions and perspectives even within a particular religion or denomination. The exploratory investigation presented here represents a pilot study to inform further research and provide potentially useful insights for science educators. The views of eight Christian minister/priests were examined concerning evolution, creationism, science, and religion. The purpose of the pilot study was not to create generalizable data or conclusions. Rather, it was to create a questionnaire/interview protocol that would (1) determine clergy views about evolution, creationism, science, and religion; (2) potentially give useful information to give to students of colleagues struggling with these issues; and (3) begin the process toward a larger study which would create generalizable data or conclusions. (Contains 25 references.) (Author/MVL)

Science, Creationism and Religion: Responses from the Clergy

by
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SCIENCE, CREATIONISM AND RELIGION: RESPONSES FROM THE CLERGY

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A long and changing history

For hundreds of years many people have seen religion and science as conflicting world views or doctrines. Discord between Galileo and his church is probably the best known example, made popular again via the best seller *Galileo's Daughter*. In the 20th century, science educators and people supporting evolution have come under fire by fundamentalist Christian denominations. Events in Kansas, Louisiana, and Michigan are recent controversies regarding evolution education that illustrate the recurring conflict of world views.

The evolution/creation public education controversy itself has a long and variable history. Ronald Numbers' (1992) *The Creationists* details the changing nature of creationists' views which precludes simplistic characterizations of the dispute. Singham (2000) splits both science and religion into two subgroups-elite science, popular science, elite religion and popular religion. Elite science is represented by the scientific community while popular science represents mistaken views held by the general public regarding natural phenomena. Elite religion is characterized by the clergy of mainstream religions while popular religion reflects a view of God that is most at odds with biological evolution. The crux of the matter is that these relationships have changed over time and Singham maintains that a questionable contemporary alliance between elite science and elite religion permits both to combine forces against popular science and popular religion.

Since at least the turn of the century the scientific community has overwhelmingly

accepted biological evolution , but when creationists' arguments are put before the general public, most citizens are confused. Both evolutionists and creationists appear to cite a great deal of evidence and the arguments seem to point to a genuine scientific debate. Consequently, when creationists ask for equal treatment of evolution and creationism in science classrooms, the general public views the situation as a "perfectly reasonable request for fair play" (Volpe, 1984; Mayer, 1984). According to several polls (Ching, 1984; Edwords, 1981), many Americans prefer that both evolution and creationism be presented to high school science students. A 1991 Gallup poll indicated that 47% of Americans agreed with the statement, "God created man pretty much in his present form at one time within the last 10,000 years."

Unfortunately, we cannot expect the general public to obtain the level of scientific literacy necessary to understand why most creationists' empirical claims are unsupported. Moreover, acceptance of evolutionary theory is largely dependent on an individual's understanding of the nature of science (Clough, 1994; Dagher and BouJaoude; 1997).

Despite an increased emphasis on the social studies of science and its implications for science education, science teachers and their students continue to exhibit misconceptions regarding the nature of science (Johnson & Peeples, 1987; McComas et al., 1998; Ryan & Aikenhead, 1992). John Moore (1983) claims that the evolution/creation controversy is, in large part, a result of misunderstandings concerning the nature of science:

> ...it becomes evermore important to understand what is science and what is not. Somehow we have failed to let our students in on that secret. We find as a consequence, that we have a large and effective group of creationists who seek to scuttle the basic concept of the science of biology.... a huge majority of citizens who, in "fairness," opt for presenting as equals the "science" of creation and the science of evolutionary biology.... It is hard to think of a more terrible indictment of

the way we have taught science.

Johnson & Peeples (1987) determined that acceptance of evolution was significantly related to understanding the nature of science. As students' understanding of the nature of science increased, they were more likely to accept evolutionary theory. Clough (1994) suggested how more accurately conveying the nature of science can diminish students' resistance to evolution education.

Evolution Education

However, students' understanding of the nature of science is but one factor that teachers must consider when teaching biological evolution. Other stakeholders affect science teachers' work and such individuals are often convinced of an irreconcilable conflict between their world view and science. The authors have had students say they're not sure whether they can believe what teachers say in their science classes, because they consider themselves to be Christians-with the implication that fundamental conflict exists between the scientific conclusions (and processes) they're taught in school and the ideas behind their religions. Parents are sometimes even more vocal than children.

"Evolution" is among the key words raising red flags in peoples' minds. Some see evolution as an atheistic, heretical idea. As a college science professor, one of us had a student provide her with creationist materials, as a gift, and another of us had a student who wasn't sure she could accept evolution (although she wasn't really sure what it was) while still being a good Catholic. Of course these are not isolated instances. Major science teaching organizations readily acknowledge the potential for conflict when teaching evolution but stress the importance of evolution in science teaching (AAAS, 1972; NABT, 1995; NSTA, 1997).

Events like these started us thinking. Most Christian denominations in the United States do not view the entire Christian Bible (hereafter referred to as simply the Bible[1]) as the inspired, inerrant word of God, *i.e.*, a book to always be taken literally. In fact, most of these denominations have issued statements acknowledging the overwhelming evidence for biological evolution and other scientific conclusions (National Center For Science Education, 2001). Official representatives from the denominations see little conflict between science and religion.

We suspect that fundamentalist 'attacks' on science probably hurt not only science, but also mainstream U.S. Christian denominations. Students, parents, school board members, and other stakeholders may erroneously believe fundamentalist-based critiques of evolution and science reflect their own denomination's position. If so, this would unnecessarily misrepresent church doctrines and hamper science education.

Hence, the science education community might have a rarely considered ally in mainstream religions found in this country. However, a religious denomination's position on such matters is usually not disseminated to its members in an officially authoritative manner. Rather, such views are filtered through clergy that serve individual churches. What views do local clergy-who directly influence parishioners-hold on the nature of science and religion? What do they tell parishioners struggling with apparent conflicts between the worldviews? An understanding of how local church leaders see the relationship and tension between science and religion could help science teachers better understand the complex nature of the evolution/education/public education controversy.

We have designed this study, then, to determine clergy's views on these issues. How do they see religion and science relating to one another? What do or would they tell

their parishioners about science and religion?

We live in a world dominated by the technological applications of scientific ideas and by the naturalistic empirical way of thinking characteristic of science. We also live in a world where many people rightfully place great importance on their faith in a supernatural being and their membership in a church. The U.S. is a highly pluralistic society represented by many different religions and perspectives even within a particular religion or denomination.

The exploratory investigation presented here represents a pilot study to inform further research and provide potentially useful insights for science educators..We examined the views of eight Christian ministers/priests about evolution, creationism, science, and religion. The purpose of the pilot study was not to create generalizable data or conclusions. Rather, we wanted to create a questionnaire/interview protocol that would (a) determine clergy views about evolution, creationism, science, and religion, (letting us compare their views with those generally accepted by the science education community), (b) potentially give us useful information we could give to students or colleagues struggling with these issues, (c) begin the process toward a larger study which *would* create generalizable data or conclusions.

Methodology

The Research Instrument

We created an instrument designed with dual purposes. The first was to ascertain respondents' viewpoints about key issues separating evolutionists and some types of creationists, as well as views about the nature of science and religion. The second purpose was to elicit clergies' comments that might be useful to science teachers and science

teacher educators concerned about science and religion (or what to tell their own students about the issue). The initial 28 Likert items also stimulated respondents' thinking on the brief questionnaire that followed. (See Appendix A).In addition to asking respondents what they believed were the major ideas in the theory of evolution, we also asked "How would you counsel a parishioner who felt that accepting the tenets of the scientific theory of evolution meant giving up their belief in God or Christianity?" and "How do you respond when people say the Bible has been proven false by science?"

Instrument items reflected prior literature and included a few modified items from Sinclair & Baldwin's (1997) study of college student views about evolution and religion. Scott's (2001) article discussing a continuum of creationist beliefs was also fruitful in helping us create survey items to discern whether respondents held particular creationist beliefs (e.g., old vs. young earth creationism, intelligent design, etc.). Dagher and BouJaoude's (1997) study of college students religious beliefs and views on evolution was also helpful.

Testing & Refining the Instrument

We interviewed eight ministers for this pilot study. The ministers were generally local. We began with a campus minister and other member of the Campus Ministry Advisory Board (Calif. State Univ. Long Beach). Other interviewees were referred by members of this board or were personal acquaintances of the authors.

As mentioned above, a primary purpose of the pilot study was to test the instrument, refine items and determine recurring themes for inclusion in future interview/survey protocols. The participants were two women and six men of which two were Presbyterians, five were Methodists and one was Catholic. Two of the ministers

have doctorates, one in religious education and the other in general ministry and administration. Included in this pilot study was a professor of Religious Studies who teaches a course entitled "Religion and Evolution" and a campus minister. All but the religion professor have attended seminary, i.e., they have degrees beyond a bachelor's. Ages of participants included two in each of the following age categories: 20-29, 40-49, 50-59, and 60-69.

The surveys and interviews were jointly administered by the first two authors. The ministers were interviewed individually and most interviews lasted over an hour, with the shortest being 45 minutes and the longest being 105 minutes.. The subjects were given the 28 Likert items and asked to complete them, after which we went through each item as a three-some to ascertain which items respondents thought were unclear. Afterwards, we asked the three open-ended questions. Both researchers took copious notes, asked for clarification and re-read relevant quotes to be sure that we had accurate notes. The first two interviews provided us with the most information regarding changes to items in the survey. Minor changes in wording of items took place between the first two interviews and the last six. These modifications do not reflect changes in content and intent, but were made to make the questions more understandable and to keep respondents from being distracted by tangential issues, e.g., referring to God as "God" and not "He".

Data Analysis

Interview data and responses to the open ended questions were sorted into groups as various themes emerged. The researchers did this independently and compared both the emergent themes and the sorting of quotes. We discussed differences and reached consensus about themes expressed by respondents. Five major themes emerged.

Survey items were similarly categorized. In this case, we used predetermined categories based on the intent of the questions. Categories included relationships between science and religion and the nature of science and religion. Additionally, the survey also examined the extent to which respondents held a literal interpretation of the Bible, were philosophically materialistic, and theistic. It also assessed various types of creationist-associated beliefs. Survey responses should have allowed us to determine where the respondents fell along the creationist continuum (Scott, 2001).

Data and Analysis

In this study we surveyed and then interviewed eight ministers regarding their thoughts on biological evolution, creationism, science, and their religions. In a society where creationist views sometimes play a role in how and what students learn about evolution, we thought it worthwhile to learn more about how ministers view these issues-since ministers may be a source of information and counseling for students parents, and other public school stakeholders regarding the relationship between religious faith and accepting biological evolution.

Our small sample focused specifically on Christian ministers, but even within that common faith myriad positions exist and the perspectives reported here in no way are claimed as representative of Christian clergy in general. In looking at our data analysis, readers should always keep in mind this work was designed as a pilot study to provide potentially useful insights for science educators and for further research. Within this framework, we nevertheless found patterns amongst the ministers' responses.

Survey Data

The sample size was too small to do meaningful statistical analysis. However,

survey responses did yield useful information. The items that were grouped by theme/topic maintained internal consistency. Findings from the survey included:

- None of the respondents were young earth creationists and none took a literal interpretation of the Bible.
- Participants agreed with the statement "I believe there were long time gaps between parts of the Genesis story,"but they were split on the issue of whether creation took seven days (regardless of the length of a "day").
- They all believed evolution occurs in all living organisms and each individual organism was not individually created. However, they had a tendency to believe that some (not all) organisms were separately created and evolution occurred within kinds.
- Their understanding of the nature of science is stronger than we had anticipated. They all understood that scientific theories are tentative, represent our best understanding to date, and are based on data. Because of this, they had difficulty responding to item #19 (evolution is a theory, as such it's highly speculative and not a proven idea). They took issue with "highly speculative".
- The group feels that science and religion do in fact overlap at times. They strongly believe that science and religion can coexist.
- All respondents generally believe in a God who intervenes directly in the physical world and plays a role in evolution.

Interview Data

Science and the Purpose of the Bible

Some creationists view the Bible as an important document for understanding

life's creation and the earth's history. Most young earth creationists accept a (more or less) literal interpretation of the account given of the earth's history in Genesis. Some old earth creationists (Scott, 2001) also come close to accepting a literal interpretation of the Genesis explanation, *i.e.*, each 'day' in Genesis was hundreds of thousands of years long, or long time gaps occurred between each day.

Every minister we interviewed believed otherwise. All saw the Bible as important, but not as a source of information for science classes, and not as a document meant to be taken literally. All saw the Bible (and Genesis) as myth, metaphor, or story-religious statements meant to convey important meanings beyond the literal words. (Note: initials in parentheses following quotes are coded to identify individual respondents.):

> "I love the creation story, but I don't see it as factual. God is part of it, and we are caretakers of creation. The story tells us about who God is, and our understanding of God. ...The Bible is stories. There is truth in the stories, but they are not based on fact. ... Facts of a story may be incorrect, but the stories point to something beyond their facts. They are not designed to relate to historical facts. They are stories." (AM)
>
> "The Bible tells us who God is but tells us nothing about science." (TJ)
>
> "A literal interpretation distorts what's there, and misses what's there. The stories are at the heart of the community-stories that have been handed down for many, many years. The stories are meant to be religious statements. They don't need [scientific] explanations. ... Narratives and myths don't require defense or proof, but literal interpretations do. ... The Bible is meant to be metaphorical, not literal. If you make it literal, you make it into an idol-and the Bible is about *not* worshiping idols." (AJ)
>
> "The Bible is storytelling. It's imaginative, so it can't be proven false by science. How can you falsify the creative?" (JQ)

Constructivism & Religion

In *When Children Ask About God* Harold Kushner (1971, p. XXIV) explicitly expresses his indebtedness to the ideas of Piaget in formulating his own perspective

regarding how to nurture children's religious development. Although our interviewees never referred to Piaget, constructivism, or conceptual change, they nevertheless made frequent statements paralleling these general ideas. Rather than discuss changing preconceptions about evolution and adaptation, as science educators do, the minsters discussed changing from a concrete or literal interpretation of the Bible toward more abstract understandings. For example:

> AJ, who mentioned people often giving up their beliefs in literal stories of the Bible around age 15 or 16, went on to say, "Changing religious views takes time. It's hard [for people] to give up what they've been taught. ... need to discuss why it's difficult to give up untenable views, why they're hard to give up-for some 'it's what I've been taught, I don't want incur the criticism of my parents or my community.' " (AJ)
>
> "We need to gauge the Christian learning curve because many folks are literal in their faith."(JQ)
>
> "Another thing that gets in the way is not being able to see how to hang on to an old idea and accept a new one. ... We need practice in what I call 'used to' thinking, *i.e.*, reminding students of times they used to think one thing and now think another." (GW)

Stumbling Blocks Toward Accepting Evolution

During the course of the interviews, the ministers discussed various stumbling blocks parishioners and others have had that interfered with full acceptance of ideas about evolution.One stumbling block, previously mentioned, is that some people interpret the Bible literally.

> "The issue is not religion, it's where you get your faith from. If you undermine scripture, and scripture underlies everything in your faith, then you've attacked an underlying thing." (TJ)

This issue, though, may involve more than mere intellectual conflict. Students may feel that challenging a literal interpretation of the Bible challenges not only their beliefs, but

also challenges their family, community, or church:

> Beliefs that interfere with accepting evolution include the idea that the Bible is to be interpreted literally, and the inerrancy of the church's authority (*i.e.*, questioning the church is not OK). (notes from GW interview)

> "K-12 students are interested in the question [about science and religion compatibility]. The real question is usually something different for adults. For example, grandma said something, she's my model, and I don't want to contradict her." (TJ)

Respondents mentioned other stumbling blocks, though. "MV" made the point that, to some, accepting evolution is seen as devaluing humans.

> "The value of the individual is important. With evolution, we run the risk of saying we emerged by pure chance, implying that we have no value. Creationists say that you have been created with intent, therefore you have value." (MV)

This point, he went on to say, is a particularly large stumbling block for early adolescents, who are developmentally self-centered. Believing in evolution makes them appear less important, he said, taking them away from the center of the universe-where, as early adolescents, they feel they belong.

Finally, one respondent also pointed specifically to lay people teaching Sunday school as a source of misinformation (including misinformation about understanding the Bible's Genesis story):

> Sunday school teachers contribute to the problem. The curriculum is usually okay but the less informed beliefs (of the Sunday school teacher) come into play-in essence they are uncredentialed teachers. They may be theologically unsophisticated or immature. Youth workers also propagate a literal/fundamentalist approach through "praise music". (notes from JA interview)

Suggestions for Talking with Parishioners

Like constructivist teachers, the ministers felt that counseling of parishioners who struggle with a conflict between evolution and creation has to start with an understanding of what the person believes and understands. They would start by asking questions and listening.

> "In counseling a parishioner who felt that belief in evolution negates his/her faith I would start at points of commonality. We both believe in creation. We'd compare their concept of a day and mine, the steps that took place, etc. We'd compare where we agree and disagree but start with the common ground. In order to heal the breach it helps to start with common ground otherwise the chasm gets larger." (WH)

> "I would question the student. Can you not believe in God if you don't believe in a 6 day creation? Let the students talk first, find out their thinking and then ask questions. Why is it that these two ideas (God the creator and evolution) are incompatible? Is it impossible to have a Creator billions of years ago versus a 6 day creation? Students need to make some interpretations themselves -- how long is a "day"? what about dinosaurs? The early peoples who wrote the Bible didn't have tools to age date." (GW)

The next step for GW and WH is to point out contradictions in the Bible, not just in the evolution story. This is not meant to undermine faith, but meant to get the person to look at the Bible differently. As mentioned earlier, these ministers do not agree with a literal interpretation of the Bible.

> "Who wrote the Bible - not Adam and Eve, they couldn't write. Writing wasn't started until long after creation." (GW)

> "I don't believe in seven 24-hour days. Who was there taking notes? There are two creation stories which conflict with each other. Genesis 1 has a seven day creation and Genesis 2 has a one day creation. The order of events differs in the two stories. In Genesis 1 man is created at the end, in Genesis 2 man is created in the middle. The order of creation is problematic, too. Plants and animals were created before the sun. How could photosynthesis occur?" (WH)

Just as the game of *telephone* results in changed messages, ministers said,

changing the way in which a story is recorded yields different messages. The Bible started as an oral tradition and was only later put down on paper. The story would necessarily change as retold over time. In some cases we can go back to source materials and see differences in the current Bible.

> "I would question students what they mean by literal interpretation. People were moved to write about their experiences and history - not God. They were moved by God, but were not taking dictation from God. Suggest an analogy - you have some experience and you want to record it - first you draw a picture, you write about it based on the picture and your remembrance. What you have written is not reality but a remembrance of reality - the same is true with the Bible. Bible is not literally God's words but the world of humans." (GW)

> Firstly, science is not out to prove the veracity of the Bible. Second, the Bible represents oral traditions, not a literal, factual book. The United Methodists say that "truth is contained in scriptures" as opposed to the scriptures being literally true. The Bible gives us background, stories to inform our faith, and has sayings attributed to Jesus as teacher and leader. It happened so long ago there is no way to know if the account is true. It is history and oral tradition, not a literal document therefore not something that can be deemed true or false. (JA)

> "The Bible is a guideline, not inerrant in terms of scripture. There are too many opportunities to look at scrolls to see that scribes made errors. They left out paragraphs, repeated the same line in different places, etc. The Bible is a faithful attempt of people to put down God's interaction with people over time." (WH)

The ministers also felt comfortable in sharing their own beliefs with parishioners. We know from research into students' willingness to give up naïve scientific understandings that conceptual change is dependent upon a new, more attractive model being present. The ministers, by sharing their understanding and views, are providing an alternative way of understanding the Bible or creation.

> "I do not see a problem in terms of compatibility between creation and evolution. I am more theistic. I believe creation/evolution is a process and God could be involved in the process." (WH)

"You're combining what cannot be combined. Evolution is not a denial of faith, but it can be an affirmation of faith." [If you see evolution as evidence of how the world came to be, and it's one of the ways the mystery of life is disclosed, how God's hand is revealed.] Biblical narratives are not meant to be scientific statements; they are (stories) that express universal truths. Creation is what God has caused." (AJ)

"To me, the message of the Bible is simple - The world is good and it is God's. Our job is to take care of it." (GW)

"The Bible sequence may not be accurate but the role of God is." (JM)

We don't know how long a [Biblical] year was at the time. The creation story says creation took, six days, but each "day" might have been much longer than a 24 hour day. ... The story does seem to follow evolution. How could the storytellers have known that?" (JA)

The ministers would try to help their parishioners see the role and purpose of the Bible as a guideline for living as opposed to a recording from God. It contains story, myth, and narrative and requires no defense. They repeatedly pointed out how it is not something that can be proven true or false in a scientific way. Science has helped us understand the Bible and points to some historical events that align with biblical stories, ministers said, but that does not make the Bible an authoritarian historical or scientific text.

Conclusions

Relationships between Science & Religion

When examining relationships between science and religious ways of understanding, scholars tend to use basically similar typologies (*e.g.*, see Barbour 2000, Nord 1999, Ratzsch 2000). For example, Barbour (2000) categorizes the relationship between science and religion as being one of either conflict, independence, dialogue, or integration. Similarly, Ratzsch describes science and religious beliefs as being

independent, inseparably blended, or related in various ways. Each of these categories has sub-categories.

Nord's (1999) categories relating science and religion are similar to the two just mentioned. His four categories are slightly simpler and more general than the others, serving better our purposes in this paper. He describes the relationship possibilities as:

1. *Religion trumps science.* "When science and religion conflict, only religion provides reliable knowledge. It is through inerrant scripture or religious tradition that we come to know the ultimate truth about nature. (p. 29)" Biblical literalists and most creation 'scientists' most clearly fall into this category.

None of the clergy we interviewed fell into this category and, indeed, most seemed vehemently opposed to a literal interpretation of the Bible.

2. *Science trumps religion.* "When science and religion conflict, only science provides reliable knowledge. It is through the methods of science that we learn the ultimate truth about nature. (p. 29)" Positions associated with this category would probably include those called scientism, philosophical naturalism, and perhaps atheism.

None of the clergy we interviewed fell into this category, either.

Although *merely opinion*, it does seem as if much of the apparent conflict between science and religion comes from people either espousing one of the above two viewpoints, or having a conception of science or religion based on one of the viewpoints. One of the minsters, GW, echoed this opinion. He said that decisions like the one made by the Kansas Board of Education about teaching evolution/creationism were 'bad news' for many Christians because they hold evolution to be compatible with their religious views. Decisions like the Kansas one "throw stones," as he said, at the ideas they believe

in. For them, the ruling implies (incorreclty) that science is bad or wrong.

3. *Independence.* ". . . science and religion can't conflict because they are incommensurable: each has its own methods; each has its own domain. . . . One common expression of this view is that science asks objective "how" questions, while religion asks personal "why" questions. (p. 29)"

The majority of the clergy we interviewed expressed views indicating they believed either the ideas within this category, or a combination of this category and the next. Here are some representative quotes:

> "The Bible is not concerned with how things happen. 99% of it is about why things happen." (TJ)
>
> "Can a mathematician invalidate a symphony? ... The Bible is about revelation and who we are with God. Everything it does is just a tool toward that goal. In that sense, the Bible and science are incompatible because they're about different things. ... They may share the same stadium, but they have different rules." (TJ)
>
> "The Bible is storytelling. It's imaginative, so it can't be proven false by science." (JQ)
>
> "Science is not out to prove the Bible false." (JA)
>
> "Biblical narratives are not meant to be scientific statements; they are (stories) that express universal truths. Creation is what God has caused." (AJ)
>
> "Ideally, evolution should be taught in science classrooms. In literature or world history, teach stories of creation from around the world. There are myriad stories. My guess is that this [evol vs creationism] is not an issue in India, where they're got multiple creation stories. They are not fighting over which is best. " (MV)

Interestingly, only one minister agreed with the survey statement "Science is based on data; religion is based on faith." In some ways this data may appear to conflict with the above statements. We believe, anecdotally, this is because the ministers' would

say they conceive of religion as being based on more than faith. One minister overtly expressed this viewpoint, talking about the role of culture in our understanding of the Bible, the Bible as metaphor, and science as a way to clarify faith. That doesn't detract, however, from their ideas about science and religion as being separate and not competitive ways of knowing.

4. *Integration.* " . . . science and religion can conflict and can reinforce each other, for they make claims about the same world. . . . a fully adequate picture of reality must draw on-and integrate-both. (p. 30)" Although the independent viewpoint may still be more widely accepted than that of integration, the last few decades have seen a shift toward acceptance of this latter view. Ian Barbour and Arthur Peacocke are among key scholars in the science/religion debate who espouse this view.

Some of the ministers we interviewed made statements indicating acceptance of an integrated view of science and religion. For example:

> "Evolution is a process of how God keeps the universe going." (TJ)
>
> "Science is moving toward unity and one-ness, and I see that as evidence of the divine." (AJ)
>
> "Why are [science and religion] considered incompatible? Can't there be a creator, with creation starting billions of years ago?" (GW)

One minister in particular, "WH," was particularly strong in his beliefs on this issue:

> "I believe creation/evolution is a process and God could be involved in the process. . . . God was involved in creation. We peel away the leaves on a head of lettuce to reveal what's underneath. That does not negate God's involvement." (WH)
>
> "The Bible and science go hand in hand. History, culture and informed criticism of the text help us make sense of scripture. The Church has often changed its mind or position on things through time (*i.e.*, the role of women, views on slavery, the role of homosexuals). In many cases it is science that has shed light on the issue." (WH)

"Science and theology can go hand in hand to understand creation. There is always a leap of faith somewhere. I believe God can act in ways seen and unseen." (WH)

Implications for teaching

When the ministers learned more about why we were conducting the study many offered ideas about how the evolution/creation debate might be addressed in classrooms.

1 Invite a panel of clergy and let students ask questions. Students can invite their own pastors to participate. Clergy can hold on to the ambiguity, maintain their faith and still accept science is like a "breath of fresh air" to students. "It's what they are looking for." (GW)

2 Ask students questions and provide alternatives that keep elements of their original ideas while offering something different (promote an "I used to think" environment). Examine the evolution in your own thinking so students can see that you have changed your beliefs over time (in essence, modeling the "I used to think" approach). (GW)

3 Help kids enjoy intellectual puzzles and figuring things out. This will help them examine their own thinking and beliefs. Most kids get stuck in regards to their faith and they are not encouraged to question or examine their thinking. (GW, TJ, MV)

4 "I am not an advocate for teaching creation in the schools. The creation story is primarily faith and theology and I don't want persons of no faith teaching doctrine." (TJ)

The campus minister provided us with a copy of a newsletter addressing the issue of

science and religion. The newsletter provided suggestions for campus ministers to begin a dialogue between the faith and science communities (Koch, 2001). The author suggests celebrating the work of scientists on your campus, starting book groups or a movie discussion group centered around works portraying the intersection of science and religion, subscribing to faith and science publications, keeping informed about issues relating faith and science, and beginning brown bag discussion groups for faculty and students to discuss these issues.

Teachers may find implementing some of these ideas difficult in particular contexts. An alternative might be to devote a bulletin board to portions of the book *Voices For Evolution* (McCollister; 1989) containing position statements in support of evolution from scientific, religious, and education organizations.

The mutual respect advocated by the clergy interviewed in this study. appears to us to be a critical beginning point in diminishing students resistance to evolution education, and it echoes earlier advice by Clough (1994) and Dagher and BouJaoude (1997). However, students must also come to understand that science has adopted epistemological and ontological presuppositions which differ from traditional belief systems. For instance, while the ministers interviewed here often spoke of God's hand in evolution, that view-while reflecting some scientists' personal beliefs-is not open to scientific investigation and hence not part of the scientific world view. This does not mean that the scientific community is atheistic, only that science can take no position on the supernatural.

Similarly, clergy may be in a better position than science educators to discern the epistemological and ontological presuppositions underlying religious ways of

understanding the world. As articluated by most of our interviewees, science and religion often look at the same world through different filters. Clergy, being fluent in the language of religion, have the knowledge and credentials to be critical of statements or ideas claimed to be religiously founded. Religious leaders may be among those best suited for speaking critically about issues that come from seeing religious traditions through a scientific worldview.

The initial mutual respect advocated by this study's interviewees creates an opportunity to address the nature of scientific thinking and the importance of understanding what is gained (and lost!) in "border crossing" to that perspective. In this way, students' personal religious beliefs are respected while developing a deeper understanding of both science and religion's place in human understanding. Students' education, science and religion would all surely profit from a deeper understanding of the rarely articulated epistemological and ontological presuppositions of science.

Next Steps

With the pilot study completed, we will likely now select a target group of clergy to study, *i.e.*, a more representative sample of clergy than examined in this study. We are considering a variety of possible groups. For now, the most likely group for study seems to be campus clergy. Within the realm of college biology teaching, campus clergy represents a group accessible-and potentially useful-to faculty and students. Thus, examining the views of campus chaplains regarding evolution, creationism, science, and religion has the potential to be useful for college biology (and geology) faculty, science educators, and students.

With initial testing indicating we have created an instrument with face validity, we

can now more formally test it for reliability and validity. A conference is held each summer for campus ministers. Our tentative plan is to distribute the reliable and valid instrument at this conference. This will permit us to have a larger and more representative sample of clergy. Although the survey was relatively unhelpful in the current study, our expectation is that we would acquire more varied and useful data when it is distributed to a sample including a wider range of views.

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Appendix A. Pilot Survey & Questionnaire

Demographic Information

Age: 20-39 40-49 50-59 60-69 70-140 >140 ☺

If you attended seminary, when did you graduate? _____

Faith: _____ Denomination: _____

Science background beyond general college requirements? _____

_____

_____

Would you say you are probably more interested in science than the general public? _____

On a scale from 0 (strong disagreement) to 10 (strong agreement), mark the extent to which you agree/disagree with the following statements.

1 _____ I think there is little or no conflict between the scientific theory of evolution and Christianity.

2 _____ Evolution is in some way part of God's overall plan.

3 _____ Based on my interpretation of the Bible, I believe the Earth is flat.

4 _____ Science is based on data; religion is based on faith.

5 _____ God used evolution during creation and we are slowly finding out how God did it.

6 _____ Based on my interpretation of the Bible, I believe the Earth is the center of the universe and the sun rotates around the Earth.

7 _____ The laws of nature are all there is; the supernatural does not exist.

8 _____ I feel that a person believing in the story of Adam and Eve found in the Bible cannot also believe in evolution.

9 _____ The Earth is probably 6,000 to 10,000 years old.

10 _____ I believe in a literal interpretation of Genesis.

11 _____ I believe creation took seven days, but each "day" might have been thousands or even millions of years long.

12 _____ The first cell had to come from somewhere. God has to fit in someplace.

13 _____ I'm OK with animals evolving but not with humans coming from another animal.

14 _____ Evolution doesn't provide any place for religious beliefs.

15 _____ Humans and all other species were specially and separately created.

16 _____ Science deals only in facts, and never with the supernatural.

17 _____ A supernatural being has acted often to cause observed changes.

18 _____ I believe there were long time gaps between parts of the Genesis story.

19 _____ Evolution is a theory, as such it's highly speculative & not a proven idea.

20 _____ God creates separate kinds of plants, animals, etc., and then evolution within kinds occurs.

21 _____ Evolutionary theory conflicts with the Bible and forces people to choose sides.

22 _____ The finding of order, purpose, and design in the world is proof of an omniscient designer.

23 _____ Acceptance of evolution and belief God in can coexist.

24 _____ Life is too complex to have occurred without the presence of an intelligent designer (God) guiding the process.

25 _____ Evolution is one way in which God creates.

26 _____ Evolution applies to other living things, but not to humans.

27 _____ Science is neutral toward religion.

28 _____ Successful scientists can also be devoted Christians.

Use as much space as you like to write responses to each of the following questions:

1. In your view, what are the major ideas in the theory of evolution?
2. How would you counsel a parishioner who felt that accepting the tenets of the scientific theory of evolution meant giving up their belief in God or Christianity?
3. How do you respond when people say the Bible has been proven false by science?

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